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GB 2198545 A GB 2163270 A GB 1130805 A
GB 0990978 A EP 0539001 A EP 0281075 A
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(54) Thermal transfer ribbon

(57) A method of thermal transfer printing utilises a thermal transfer ribbon comprising a base film 10, an optional release layer 12 a first transfer layer 11 and a second transfer layer 13 with an optional backing layer 14. Selected areas of both said first and second transfer layers are transferred to the print receiving surface. The first and second transfer layers are formed of different materials as set out below.

In one embodiment a layer of visible pigment and a layer of luminescent pigment are used to print bar codes.

In another embodiment an adhesive layer is combined with a pigmented, preferably magnetic, layer to ensure adhesion of print.

In another embodiment a heat indicating layer is combined with a pigmented masking or backing layer.

A three layer construction of (conductive/insulative/conductive) materials is disclosed as especially suitable for printing radio responsive anti-theft aerial togs (or labels) for merchandise security in retail establishments. (Fig 3)

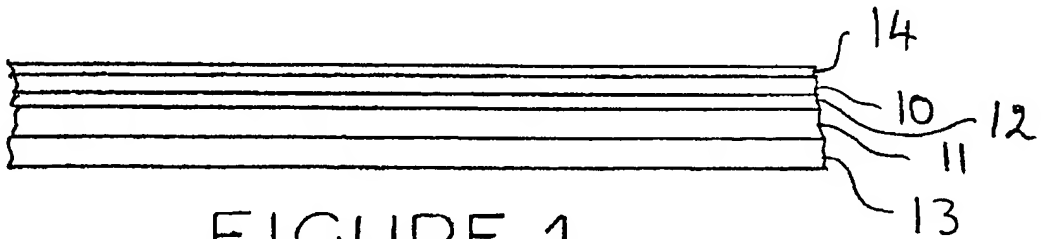

FIGURE 1

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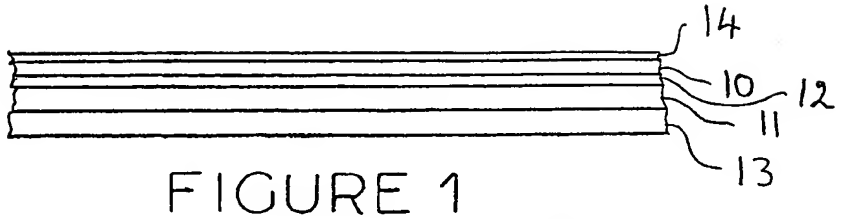

FIGURE 1

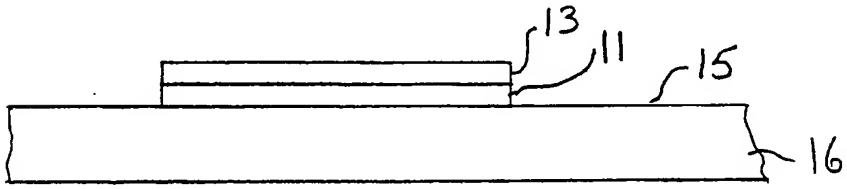

FIGURE 2

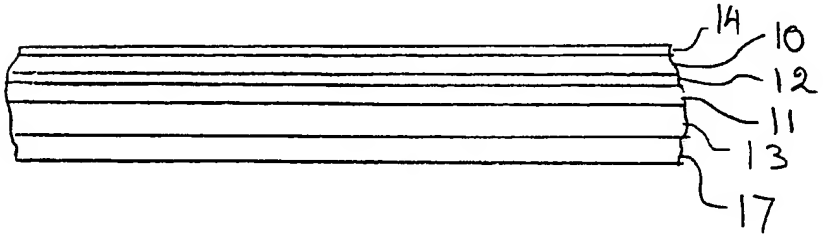

FIGURE 3

THERMAL TRANSFER PRINTING RIBBON AND METHOD OF PRINTING

This invention relates to thermal transfer printing and in particular to thermal transfer printing ribbons used in such printing techniques.

In thermal transfer printing using a thermal transfer ink ribbon, an ink layer of the ribbon carried on a base film is brought into engagement with a surface of a print receiving medium and selected areas of the ribbon are heated by thermal elements of a thermal print head to cause the ink layer in those areas to adhere to the surface of the print receiving medium to a sufficient extent that on separation of the ribbon from the surface of the print receiving medium the ink layer in those areas separates from the base film and remains adhered to the print receiving medium to form a required print impression.

Commonly, thermal ink transfer ribbons have a single ink layer and substantially the entire thickness of the layer in those areas which are heated is transferred from the base film of the ribbon to the print receiving medium. It is also known to use so called multi-strike ribbons in which a plurality of ink layers are superimposed on the base film. In use, when such ribbons are heated selectively, the outermost ink layer in the heated areas is transferred from the ribbon to the ink receiving medium and the underlying ink layers remain adhered to the base film. Accordingly the ribbon may be utilised in a plurality of passes past the thermal print head.

According to one aspect of the present invention a method of thermal transfer printing comprises providing a thermal transfer ribbon including a base film supporting at least first and second transfer layers, said first transfer layer being superimposed on and bonded to said second transfer layer; feeding the ribbon and a print receiving

medium past a thermal print head with said first transfer layer in engagement with a print receiving surface of the print receiving medium; and operating the print head to apply heat to selected areas of the ribbon to cause transfer of both said first and second transfer layers in said selected areas to said print receiving surface to produce a print impression comprising said selected areas of said first layer and corresponding areas of said second layer superimposed thereon, said first and second transfer layers being formed of different materials such as to contribute different properties or characteristics to the first and second layers of the print impression.

According to a second aspect of the present invention a thermal transfer ribbon comprises a base film; a first transfer layer carried by said base film; a second transfer layer superimposed on said first transfer layer and bonded to said first transfer layer; said first transfer layer being separable in a thermal printing operation to produce a print impression from the base film while maintaining the bond between said first and second transfer layers; said first and second transfer layers being formed of different materials such as to contribute different properties or characteristics to the print impression.

According to a third aspect of the invention a method of manufacturing a thermal transfer ribbon as hereinbefore defined includes the steps of applying to a base film a first coating of substantially uniform thickness consisting of a first composition in liquid form comprising first material to form the first transfer layer and a solvent; evaporating the solvent to leave said first transfer layer of said first material carried by the base film; applying to said first layer a second coating of substantially uniform thickness consisting of a second composition at an elevated temperature at which the

composition is fluid and then allowing the composition to cool to form the second transfer layer superimposed on said first transfer layer.

Alternatively the second transfer layer may be formed by the steps of applying to said first layer a second coating of substantially uniform thickness consisting of a second composition in liquid form comprising second material to form the second transfer layer and a solvent; evaporating the solvent to leave said second transfer layer formed of said second material superimposed on said first transfer layer.

Embodiments of the invention will now be described by way of example with reference to the drawings in which:-

Figure 1 is a sectional view of a thermal transfer ink ribbon in accordance with the invention

Figure 2 is a sectional view of a printed impression produced by utilisation of the print ribbon shown in Figure 1 and

Figure 3 is a sectional view of a further form of ink transfer ribbon in accordance with the invention.

Referring first to Figure 1, a thermal transfer ink ribbon comprises a base film 10, typically formed of polyester, to provide mechanical support for other layers of the ribbon. The base film may have a thickness in a range of 2u - 8u. A first transfer layer 11 is supported by the base film 10. The transfer layer 11 may be deposited directly onto a front surface of the base film or preferably, as shown in Figure 1, a release layer 12 is deposited on the front surface of the base film prior to deposition of the transfer layer 11 and the transfer layer 11 is deposited on the release layer 12. The release layer is formed of a material which facilitates peeling of the base film from those areas of the transfer layer which during a thermal printing operation have been heated to

cause transfer of those areas from the base film to a print receiving medium but also prevents or reduces flaking of the transfer layer from the base film during normal handling of the ribbon. The release layer may be formed of polysilane or wax and may be deposited at a rate in the range of 0.01 - 0.08 gm/square metre. A second transfer layer 13 is deposited on the first transfer layer 11. The second transfer layer partially comingles with the first transfer layer in the region of the interface between the first and second layers and thereby bonds the second transfer layer and the first transfer layer together. The first and second transfer layers are formed of materials such as to impart different properties or characteristics, for example visual properties or characteristics, to a print impression formed by selective thermal transfer of the first and second transfer layers from the ribbon as will be explained in more detail hereinafter. If desired, to facilitate feeding of the ribbon through a printing device and to prevent burn through when the ribbon is subjected to heating by thermal print elements, the rear face of the base film may be coated with a back coating 14. The back coating 14 may comprise a cured silane compound or other suitable compound.

In a thermal transfer printing operation utilising the ribbon described hereinbefore with reference to Figure 1, the second transfer layer 13 is brought into engagement with a surface 15 of a print receiving medium 16 and heat is applied selectively to the rear of the base film to heat selected areas of the first and second layers. As a result of the heating of the selected areas of the first and second layers the areas of the second transfer layer 13 are caused to adhere to the surface 15 of the print receiving medium and after passing the print head the base film 10 is peeled from the first transfer layer 11 to leave the areas of the second transfer layer 13 adhered to

the print receiving medium and corresponding areas of the first transfer layer 11 adhered to the transferred areas of the second transfer layer 13.

It will be appreciated that the first and second transfer layers are bonded together more strongly than the first transfer layer adheres to the base film, or release layer. Accordingly in those selected areas in which heat is applied to the ribbon, the first and second layers are transferred together from the ribbon to the print receiving medium. Furthermore it will be understood that since the transferred areas of the second transfer layer adhere to the print receiving medium and the corresponding transferred areas of the first transfer layer lie superimposed on the areas of the second transfer layer the visual appearance of the printed impression will comprise that due to the first transfer layer backed by that due to the second transfer layer.

Examples of the composition (parts by weight) of materials to form the ink transfer layers are as follows:-

First transfer layer	
Antioxidant	0.3
Polyethylene wax	12.3
Polyamide	6.2
Dispersal agent	0.5
Pigment	6.2
Toluene	43.2
Ethanol	30.9

Second transfer layer	
Crude montan wax	1.2
Refined carnauba wax	3.0
Polyethylene wax	2.0
Dispersal agent	0.4
Pigment and/or dye	1.4

Synthetic resin	0.3
Extender	1.0
Slip agent	0.3

The material to form the first transfer layer is spread as a coating of uniform thickness on the base film, or on the release layer if provided, in a liquid state and the solvents are evaporated to leave the first transfer layer, in a solid state, of uniform thickness having a weight of approximately 1.0 to 5.0 gm/square metre.

The material to form the second transfer layer is heated to melt the wax constituents of the material and the material is spread as a coating of uniform thickness having a weight of approximately 1 to 4 gm/square metre on the solid first transfer layer. Upon cooling the material solidifies to form the second transfer layer of substantially uniform thickness. The heated material to form the second transfer layer partially comingles with the first transfer layer in the region of the interface between the layers and thereby the first and second layers are bonded together.

Instead of spreading the material of the second transfer layer in a hot melt process, the second transfer layer may be applied in the same manner as the first transfer layer in a solvent process. An example of the composition of the material to form the second transfer layer when using a solvent process is as follows:-

Antioxidant	0.25
Dispersal agent	0.54
Phenolic resin	19.15
Fluoro polymer	7.50
Pigment and/or dye	6.00
MEK	70.00

The compositions of the first and second transfer layers set out hereinbefore are merely typical examples of compositions thereof and it is to be understood that the components and the proportions of the components may be varied as may be desired for different applications in which the ribbon may be required to be used.

The use of a thermal transfer ribbon comprising two bonded ink layers which are transferred together in a single printing operation by a single thermal print head is useful in a number of printing applications of which the following are examples.

There is a requirement to print code markings, such as bar codes, in a visible form which can be machine read and in a form which is excited by ultra-violet to emit light in the visible spectrum. By utilising a two layer thermal transfer ink ribbon, the visible and ultra-violet excited code marking can be printed in superimposition with a single print head in a single printing operation. The pigment in the composition of the first ink transfer layer is selected to be readily visible, for example black, and the composition of the second ink transfer layer contains a fluorescent component. Accordingly when the code markings are printed the fluorescent component in the impression overlies the visible pigment and the visible ink is readily visible through the fluorescent layer.

Devices for indicating temperature are known which use thermo-chromic material which changes colour over a predetermined range of temperatures. Such devices comprise a transparent substrate to the rear of which substrate an overall coating of thermo-chromic material is applied, for example as a liquid which is then dried. In order to render the thermo-chromic material visible in selected areas opaque, usually black, ink is applied to the selected areas of the coating of thermo-chromic

material. Thus not only is the coating of thermo-chromic material applied to areas which are not to be utilised but the application of the thermo-chromic coating and of the opaque layer requires two separate operations. In accordance with the present invention, a two layer thermal transfer ribbon may be utilised to apply both the thermo-chromic material and the opaque material in corresponding selected areas on a suitable receiver surface, either the rear of the transparent substrate, or the front of an opaque substrate, in a single printing operation using a single thermal print head. The composition of one transfer layer is such as to provide an opaque print impression and the other transfer layer contains thermo-chromic material, the disposition of the two layers in the ribbon being chosen in accordance with whether the printing is to be effected on the rear of a transparent receiver or on the front face of the receiver. Thus the thermo-chromic material is printed in selected areas directly onto the substrate and the opaque material extends over corresponding areas and overlies the rear of the thermo-chromic material. When the device is viewed the thermo-chromic material is seen backed by the opaque layer.

When printing on a print receiving medium having a poor quality print receiving surface there is a tendency for the adhesion between the ink transfer layer and the surface to be poor or for it to be randomly spread. As a result when printing code markings such as bar codes or codes for magnetic ink character recognition portions of the code may be missing from, or smeared over, the printed impression. In order to improve the quality of printing which can be attained on poor quality surfaces, the second ink transfer layer is formed of a material of which the composition provides good adhesion, smoothing characteristics while the first ink transfer layer is formed of a material of which the composition provides the

required recognition characteristics, for example for visual and/or magnetic sensing. The characteristics of the second ink transfer layer ensure improved adhesion and quality to the print receiving medium of the markings printed with the first ink transfer layer.

A two layer ribbon in accordance with the present invention may be utilised to form electrically conductive and insulated tracks by a single printing operation. One of the transfer layers comprises a layer of material having good electrical conductivity and the other of the transfer layers comprises a layer of material which is electrically insulating. If the electrically conductive tracks are to be formed on an insulating substrate, the second transfer layer 13 may be conductive and the first transfer layer 11 insulating so that, when printing is effected by thermal transfer of the first and second transfer layers, one or more conductive tracks are printed onto the surface of the substrate and insulating material corresponding to the conductive track or tracks overlies the track or tracks. Alternatively the first transfer layer 11 may contain conductive material and the second transfer layer 13 contain insulating material in which case the thermal transfer printing operation will form one or more tracks of conductive material overlying identical tracks of insulating material. By this means conductive tracks in a plane and insulating tracks underlying or overlying the conductive tracks are formed in a single printing operation. When it is desired to produce an electrical circuit comprising conductive tracks in more than one plane, conductive tracks in additional planes may be formed by a succession of further printing operations, the insulating tracks formed in each operation providing electrical isolation between conductive tracks printed in successive printing operations.

Where it is desired to produce an electrical circuit which

comprises conductive tracks in two planes and electrically isolated by insulating material, the thermal transfer ribbon may be provided with three transfer layers as shown in Figure 2. A first transfer layer 11 is formed of or contains electrically conductive material, a second transfer layer 13 superimposed on the first transfer layer is formed of electrically insulating material and a third transfer layer 17 is formed of or contains electrically conductive material. The three transfer layers adhere together and when the ribbon is subjected to heating in a thermal printing operation, all three transfer layers in the area of the ribbon subjected to heating are transferred from the base film 10 to the print receiving medium. Thus a pattern of electrically conductive first tracks is printed onto the print receiving medium with an overlying corresponding pattern of insulating material and a corresponding pattern of electrically conductive second tracks overlying the first tracks, the pattern of second tracks being electrically insulated from said first tracks by the pattern of insulating material. An example of an electrical circuit which may be produced by thermal transfer printing using a thermal transfer ribbon having three transfer layers is a so-called "aerial" pattern used on security labels in retail shops to protect against theft of articles. Since the printing can be effected by means of a digital thermal print head operable to print dots at a plurality of selected positions different patterns of conductive tracks may be readily produced as required. Furthermore since the printing enables formation of two conductive tracks separated by insulating material in a single pass of a single printing head the conductive patterns are aligned with one another and difficulties associated with multi-pass printing are not present. Accordingly security labels of this type can be produced easily and cheaply as required.

While examples have been described hereinbefore of

applications of thermal transfer printing using a thermal transfer ribbon having two or more transfer layers bonded together and in which selected corresponding areas of all the transfer layers are transferred from the ribbon to a print receiving medium at the same time in a single pass of a single thermal print head it is to be understood that the present application is not limited to those methods described hereinbefore and it will be appreciated that this method of thermal transfer printing may be utilised for modifications of these applications and for other applications. The transfer layers may be formed of materials including ink or dye to provide a visually or optically readable printed impression or may be formed of materials to provide other properties or characteristics such as electrically conductive or insulating to the printed impression.

CLAIMS

1. A method of thermal transfer printing comprising providing a thermal transfer ribbon including a base film supporting at least first and second transfer layers, said first transfer layer being superimposed on and bonded to said second transfer layer; feeding the ribbon and a print receiving medium past a thermal print head with said first transfer layer in engagement with a print receiving surface of the print receiving medium; and operating the print head to apply heat to selected areas of the ribbon to cause transfer of both said first and second transfer layers in said selected areas to said print receiving surface to produce a print impression comprising said selected areas of said first layer and corresponding areas of said second layer superimposed thereon, said first and second transfer layers being formed of different materials such as to contribute different properties or characteristics to the first and second layers of the print impression.

2. A thermal transfer ribbon comprising a base film; a first transfer layer carried by said base film; a second transfer layer superimposed on said first transfer layer and bonded to said first transfer layer; said first transfer layer being separable in a thermal printing operation to produce a print impression from the base film while maintaining the bond between said first and second transfer layers; said first and second transfer layers being formed of different materials such as to contribute different properties or characteristics to the print impression.

3. A thermal transfer ribbon as claimed in claim 2 wherein the first transfer layer is formed of or contains a material excitable by ultra-violet light to emit light in a visible range of the spectrum and the second transfer layer contains an optically opaque ink.

4. A thermal transfer ribbon as claimed in claim 2 wherein the first transfer layer contains magnetic material and the second transfer layer is formed of a material selected to provide good adherence to a print receiving surface.

5. A thermal transfer ribbon as claimed in claim 2 wherein the first transfer layer includes thermo-chromic material and the second transfer layer includes optically opaque ink.

6. A thermal transfer ribbon as claimed in claim 2 wherein one of the first and second transfer layers includes electrically conductive material and the other of said transfer layers is formed of electrically insulating material.

7. A thermal transfer ribbon as claimed in claim 2 wherein the first transfer layer includes electrically conductive material and the second transfer layer is formed of electrically insulating material and including a third transfer layer superimposed on and bonded to said second transfer layer; said third layer including electrically conductive material and said second transfer layer being effective to electrically isolate the first and second transfer layers.

8. A thermal transfer ribbon as claimed in any one of claims 2 to 7 wherein the first transfer layer is formed in a solvent process and the second layer is formed in a hot melt process.

9. A thermal transfer ribbon as claimed in any one of claims 2 to 7 wherein the first and second transfer layers are formed in a solvent process.

10. A method of manufacturing a thermal transfer ribbon as claimed in any one of claims 2 to 7 including the steps of applying to a base film a first coating of substantially uniform thickness consisting of a first composition in liquid form comprising first material to form the first transfer layer and a solvent; evaporating the solvent to leave said first transfer layer of said first material carried by the base film; applying to said first layer a second coating of substantially uniform thickness consisting of a second composition at an elevated temperature at which the composition is fluid and then allowing the composition to cool to form the second transfer layer superimposed on said first transfer layer.

11. A method of manufacturing a thermal transfer ribbon as claimed in any one of claims 2 to 7 including the steps of applying to a base film a first coating of substantially uniform thickness consisting of a first composition in liquid form comprising first material to form the first transfer layer and a solvent; evaporating the solvent to leave said first transfer layer formed of said first material carried by the base film; applying to said first layer a second coating of substantially uniform thickness consisting of a second composition in liquid form comprising second material to form the second transfer layer and a solvent; evaporating the solvent to leave said second transfer layer formed of said second material superimposed on said first transfer layer.

12. A method of thermal transfer printing utilising a thermal print head and a thermal transfer ribbon as claimed in any one of claims 2 to 7.

13. A method of thermal transfer printing substantially as hereinbefore described with reference to the drawings.

14. A thermal transfer print ribbon constructed and

arranged to be used substantially as hereinbefore described with reference to the drawings.

15. A method of manufacturing a thermal transfer ribbon having first and second superimposed transfer layers substantially as hereinbefore described with reference to the drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9316818.5
Relevant Technical Fields (i) UK Cl (Ed.L) G2C (CFD, CFE, CFM, CFY, CAS) (ii) Int Cl (Ed.5) B41M	Search Examiner M K B REYNOLDS Date of completion of Search 4 NOVEMBER 1993
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Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2198545 A	(CANON) Figures 8-9, pages 23-28, examples	1-2, 4 and 6 at least
X	GB 2163270 A	(RICOH) Figure 4 and page 6 lines 56-61	1-3 at least
X	GB 1130805	(RITZERFELD) Figures 4, 7-8 and examples	1-2 and 6 at least
X	GB 990978	(COLUMBIA RIBBON) Figures 2-3 and page 3	1-2, 4 and 6 at least
P, X	EP 0539001 A	(MMM) examples	1-3 at least
X	EP 0281075 A	(CANON) figures and examples	1-2, 4 and 6 at least
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X	WO 91/06829 A	(KROY) Figure 2 and examples	1-2, 4 and 6 at least

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